We Claim:

1. A method of inserting pilot symbols into Orthogonal Frequency Division Multiplexing (OFDM) frames at an OFDM transmitter having at least one transmitting antenna, the OFDM frames having a time domain and a frequency domain, each OFDM frame comprising a plurality of OFDM symbols, the method comprising the steps of:

for each antenna, inserting scattered pilot symbols in an identical scattered pattern in time-frequency.

2. A method according to claim 1 wherein the identical scattered pattern is a regular diagonal-shaped lattice.

3. A method according to claim 2 wherein for each antenna, inserting pilot symbols in an identical diagonal-shaped lattice comprises for each point in the identical diagonal shaped lattice inserting a number of pilot symbols on a single sub-carrier for N consecutive OFDM symbols, where N is the number of transmitting antennae.

4. A method according to claim 3 wherein the diagonal shaped lattice is a diamond shaped lattice.

5. A method according to claim 3 further comprising for each point in the diagonal-shaped lattice:

generating L uncoded pilot symbols;

performing space time block coding (STBC) on the group of L uncoded pilot symbols to produce an NxN STBC block, L and N determining an STBC code rate;

transmitting one row or column of the STBC block on each antenna on a specific sub-carrier.

6. A method of claim 1 further comprising transmitting the pilot symbols with a power level greater than a power level of data symbols, depending upon a value reflective of channel conditions.

7. A method of claim 4 further comprising transmitting the pilot symbols with a power level which is dynamically adjusted to ensure sufficiently accurate reception as a function of a modulation type applied to the sub-carriers carrying data.

8. A method according to claim 2 wherein the diagonal shaped lattice pattern comprises:

a first plurality of equally spaced sub-carrier positions;

a second plurality of equally spaced sub-carrier positions offset from said first plurality;

wherein the pilot symbols are inserted alternately in time using the first plurality of equally spaced sub-carrier positions and the second plurality of equally spaced sub-carrier positions.

9. A method according to claim 8 wherein the second plurality of sub-carriers is offset from the first plurality of equally spaced-subcarrier positions by half the spacing between adjacent sub-carriers of the first plurality of sub-carrier positions thereby forming a diamond shaped lattice pattern.

10. The method of claim 1 wherein the pilot pattern is cyclically offset, both in a time direction and in a

frequency direction, for at least one adjacent base station to form re-use patterns.

11. An OFDM transmitter comprising:

a plurality of transmit antennas;

the OFDM transmitter being adapted to insert pilot symbols into Orthogonal Frequency Division Multiplexing (OFDM) frames having a time domain and a frequency domain, each OFDM frame comprising a plurality of OFDM symbols by, for each antenna, inserting pilot symbols in an identical scattered pattern in time-frequency.

12. A transmitter according to claim 11 wherein the identical scattered pattern is a diagonal-shaped lattice.

13. An OFDM transmitter according to claim 11 wherein for each antenna, inserting pilot symbols in an identical scattered pattern comprises for each point in the identical scattered pattern inserting a number of pilot symbols on a single sub-carrier for N consecutive OFDM symbols, where N is the number of transmitting antennae, where N>=1.

14. An OFDM transmitter according to claim 13 wherein the scattered pattern is a diamond shaped lattice.

15. An OFDM transmitter to claim 11 further adapted to, for each point in the scattered pattern:

generate L uncoded pilot symbols;

perform space time block coding (STBC) on the group of L pilot symbols to produce an NxN STBC block;

transmit one row or column of the STBC block on each antenna.

16. An OFDM transmitter according to claim 15 wherein the scattered pattern is a diamond-shaped lattice.

17. An OFDM transmitter according to claim 11 further adapted to transmit the pilot symbols with a power level greater than a power level of data symbols depending on a value reflective of channel conditions.

18. An OFDM transmitter according to claim 11 further adapted to transmit the pilot symbols with a power level which is dynamically adjusted to ensure sufficiently accurate reception.

19. An OFDM transmitter according to claim 16 wherein the diamond shaped lattice pattern comprises:

a first plurality of equally spaced sub-carrier positions;

a second plurality of equally spaced sub-carrier positions offset from said first plurality;

wherein the pilot symbols are inserted alternately in time using the first plurality of equally spaced sub-carrier positions and the second plurality of equally spaced sub-carrier positions.

20. An OFDM transmitter according to claim 19 wherein spacing between locations of the diamond lattice pattern are optimized to allow a fast extraction of scattered pilot symbols without requiring the computation of a complete FFT.

21. A method of estimating a plurality of channel responses at an Orthogonal Frequency Division Multiplexing (OFDM) receiver having at least one receive antenna, the method comprising:

at each receive antenna receiving OFDM frames transmitted by at least one transmitting antenna, the OFDM frames having a time domain and a frequency domain, the OFDM frames transmitted by each antenna having pilot symbols inserted in an identical scattered pattern in time-frequency, each OFDM frame comprising a plurality of OFDM symbols;

for each transmit antenna, receive antenna combination:

a) using the pilot symbols of the received OFDM frames to estimate a channel response for each point in the scattered pattern;

b) estimating the channel response of a plurality of points not on the scattered pattern by performing a two-dimensional (time direction, frequency direction) interpolation of channel responses determined for points in the scattered pattern;

c) performing an interpolation in the frequency direction to estimate the channel responses corresponding to remaining OFDM sub-carriers within each OFDM symbol.

22. A method according to claim 21 further comprising:

performing a filtering function on the channel responses prior to performing the interpolation in the frequency direction to estimate the channel responses corresponding to remaining OFDM sub-carriers within each OFDM symbol

23. A method according to claim 21 wherein the scattered pattern is a regular diamond shaped lattice.

24. A method according to claim 23 wherein estimating the channel response of a plurality of points not on the scattered pattern by performing a two-dimensional (time direction, frequency direction) interpolation of channel responses determined for points in the scattered pattern lattice comprises:

for each sub-carrier to be estimated averaging channel responses of the given channel estimation period of a sub-carrier before the subcarrier to be estimated in frequency (when present) and a sub-carrier after the subcarrier to be estimated in frequency (when present) and the channel response for a previous estimation period (when present) and a following estimation period (when present).

25. A method of claim 22 wherein filtering the channel responses comprises performing a three-point smoothing operation.

26. A method of claim 21 wherein performing an interpolation in the frequency domain comprises performing a linear interpolation for sub-carriers at a lowest or highest useful frequency within the OFDM symbol and performing a cubic Lagrange interpolation for sub-carriers at frequencies not equal to the first or the last useful frequency.

27. A method according to claim 21 applied to a single transmitter, single receiver system.

28. A method according to claim 21 applied to a single transmitter system wherein each point in the scattered pattern contains a single pilot symbol.

29. A method according to claim 21 applied to a system in which there are N>=2 transmit antennas, and wherein each

point in the scattered pattern contains a number N of consecutive encoded pilot symbols transmitted on a sub-carrier, a single channel estimate being determined for each N encoded pilot symbols.

30. A method according to claim 29 wherein the N encoded pilot symbols contain L pilot symbols which were STBC block coded, where N and L together determine a STBC code rate.

31. A method according to claim 21 wherein the scattered pattern is a regular diagonal-shaped lattice.

32. A method according to claim 31 wherein the regular diagonal-shaped lattice is a diamond shaped lattice.